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Breeding Biology of *Eleutheronema tetradactylum* (Shaw, 1804) from the Bay of Bengal, Indian Ocean

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Abstract: Berried females of *Eleutheronema tetradactylum* (Shaw, 1804) were collected from the fish landing center of Chittagong (Bay of Bengal, Indian Ocean) to estimate the maturity stages, gonadosomatic index (GSI), ova diameter, fecundity, breeding time and both the macroscopic and microscopic appearance. Data were collected for consecutive 12 months following seasonal pattern of pre-monsoon, monsoon and post-monsoon. Study revealed that *E. tetradactylum* double breeder and one was from February to March and another one was from July to August. The GSI was recorded within 1.04 to 18.33. The ova diameter was found ranging from 0.40 mm to 0.79 mm and highly related ($r = 0.846$, $p<0.05$) with mean GSI. Fecundity was observed 1005219.00 to 2091927.00, which showed high fecundity compared to other marine fishes. Fecundity of *E. tetradactylum* was not significantly related to the total body weight and length.

Key words: Biology · *Eleutheronema tetradactylum* · GSI · Fecundity

INTRODUCTION

The species *Eleutheronema tetradactylum* (Shaw, 1804) is commonly known as Indian Salmon or four fingers thread fin in English and Rishi Kuchi or Tailla in Bengali. Commonly, it is found in the coastal shallow water of the Bay of Bengal of Indian Ocean at the depth of 20-100 m [1]. It is also reported on the Hooghly estuarine system, India and its tributaries. In worldwide, this species is widely distributed along the coasts of South Africa, Madagascar, Pakistan, China, Taiwan, Malaysia, Indonesia, Thailand, Philippines, Hong Kong and Queensland. Being as Polynemids species, they are carnivorous in nature with the characteristics of predaceous, voracious and cannibalistic [2]. In young stage, they feed on plankton like copepods, nauplii and amphipods with their filter feeding mechanism. As they grow, their food changes gradually to slightly larger plankton like mysids, megalopa larvae, small prawns and fish larvae. The food of the adults consists of polychaetes, decapodes, stomatopods and fish. Malhotra [3] observed that *E. tetradactylum* exhibits different behavior at different length viz., size group I (7-30 mm) fed exclusively on copepods and mysids and occasionally on lucifers; size group II (30-60 mm) fed on planktonic crustaceans, larvae and post larvae of teleostean fish and size III (60 mm and above) fed on crustaceans and fish in marine environment and polychaetes in the estuaries.

This species contributes a good fishery in the Bay of Bengal estuarine system. This species is an excellent food fish and migrate higher up the rivers than any of the other polynemids. Mature *E. tetradactylum* enters into the estuary for breeding when salinity of water starts rising. Young ones are found in abundance in the lower reaches of the estuaries of the Bay of Bengal and the fishery of this species in this part of Bangladesh is sustained by the juveniles. This fish has a great demand among the peoples of coastal districts. The demand *of E. tetradactylum* in the national markets is high and growing fast [2].

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Knowledge on fish breeding biology is important to evaluate the commercial potentiality of its stock, life cycle, culture and management [4, 5]. Several studies on pelagic and demersal fish breeding biology had been conducted so far worldwide [6, 7]. However, though *E. tetradactylum* is one of the highly esteemed table fish both at home and abroad, yet very little work has so far been reported on its breeding biology from the Bay of Bengal. Hence, this study was conducted to investigate the breeding biology considering the economic importance of this species.

MATERIALS AND METHODS

A total of 24 berried females of *E. tetradactylum* were collected in different seasons (Pre-monsoon, monsoon and post-monsoon) from the fish landing (Fishery Ghat) centre of Chittagong, Bangladesh for this study. The collected fishes were immediately brought to the Laboratory of the Institute of Marine Sciences and Fisheries, University of Chittagong for future analysis. All specimens were washed thoroughly with tap water. Total length and standard length of each fish were measured in nearest centimeter (cm). Body weight of each fish was measured by means of a pan balance in nearest gram (g). Before weighing the fishes, excess water was removed with blotting paper. Ovary from the each fish was removed by dissecting out the abdomen. The two lobes of each ovary were dried off by removing excess fluid with blotting paper. They were then weighed on a pan balance to the nearest 0.01 g. Ovary of the fish was categorized as immature, maturing, mature and spent. Fecundity was determined by following the method of Healy and Nicol [8]. Five cross sectional samples were taken randomly from anterior, middle and posterior regions of the two lobes of each ovary. The eggs in each sample of five sections were counted and mean value was then calculated. The diameter of eggs was determined with the help of an ocular micrometer. Gonadosomatic Index (GSI) was computed by following the method described by Kader [9]. The value of correlation co-efficient (r) between fecundity and total length, standard length, body weight and gonad weight were calculated. The regression lines of fecundity on the aforesaid parameters were established. All of the statistical analyses were carried out by following Spiegel [10] and the mathematical relationships between fecundity and that of the other parameters were determined by following Lagler [11].

RESULTS AND DISCUSSION

The total length of the sampled fish ranged from 40.5 cm to 53 cm with the total body weight of the berried female ranged from 800 g to 1650 g followed by gonad, ranged from 10 g to 245 g (Table 1). The female reproductive organs of *E. tetradactylum* consisted of bi-lobed gonads. The ovaries were found situated in the body cavity vertical to the kidney and dorsal part of the digestive tract. The two ovarian *E. tetradactylum* were more or less spindle shaped and generally, of the same size but in many cases the right ovary is a little bit longer than the left. Both the ovaries was observed slightly narrower tapering interiorly and broader posteriorly. The entire ovary was bounded in fibrous connected tissues which separated the organ from the surrounding hemocael. The ovarian lobes are connected along the dorsal surface by mesenteries and are suspended in the abdominal cavity.

Based on color changes, external morphology, transparency, ova size the ovary was divisible into four maturity stages i.e., immature, maturing, mature and spent, which showed the detail of the morphological changes taking place in different maturity stages of the ovary (Table 2). In immature stage, thin ovaries were found occupying half length of body cavity, pinkish in color, shape irregular, nucleus clearly visible, ova translucent. Egg diameter ranged from 0.40 mm to 0.51 mm. Gonado Somatic Index (GSI) ranged from 0.71 to 4.62. The immature stock of ova (Diameter about 0.10 mm) was found in all the subsequent stages of ovary, which was in close agreement with the observation of Gupta [12]. Maturing stage was characterized by yellowish pink ovaries occupying two third of the body cavity, ova shape spherical and partially opaque, nucleus invisible. Egg diameter ranged from 0.52 mm to 0.60 mm and GSI ranged from 4.64 to 13.75. Studies by Gupta [12] and Kagwade [13] also reported the same (0.30-0.75 mm) size of ova elsewhere and comparable with the present findings. In mature stage, ovaries were found thicker, granular occupying almost whole length of body cavity, creamy to light yellowish in color; ova shape almost spherical, extraction of ova possible by slight pressure on abdomen. Egg diameter ranged from 0.61 mm to 0.79 mm with the GSI ranged from 13.81 to 18.33. Spent stage was characterized by small ovaries with lose tissues and fibrous flaccid, reddish in color and growing oocytes as in stages 1 and 2. In spent stage, egg diameter ranged from 0.40 mm to 0.43 mm and GSI ranged from 1.20 to 2.67.

Table 1: Observations of breeding performance of *E. tetradactylum* (Shaw, 1804) collected from Bay of Bengal, Indian Ocean

Collection period	Total length (cm)	Standard length (cm)	Total body weight (g)	Gonad weight (g)	GSI	Fecundity	Egg diameter (mm)
Post-monsoon	43-52.5	32-40.5	1100-1600	38-228	3.46-13.75	1711226-2051786	0.40-0.58
Pre-monsoon	50-53	39-41	1400-1650	10-245	0.71-16.33	1101378-1819219	0.40-0.79
Monsoon	41-47	29-34	800-1200	12-220	1.20-17.80	1005219-2091927	0.40-0.69

Table 2: Color, size, gonadosomatic index and ova diameter in different maturity stages in the ovary of *E. tetradactylum* (Shaw, 1804)

Maturity stages	Color	GSI	Ova diameter (mm)
Immature	Pinkish	0.71-4.62	0.40-0.51
Maturing	Yellowish pink	4.64-13.75	0.52-0.60
Mature	Yellowish	13.81-18.33	0.61-0.79
Spent	Reddish	1.20-2.67	0.40-0.43

Table 3: Seasonal variation of mean GSI and ova diameter of *E. tetradactylum* (Shaw, 1804)

Collection period	No. of fish	Mean range	Mean range of ova diameter (mm)
Post-monsoon	09	5.47-13.91	0.42-0.66
Pre-monsoon	07	1.04-15.67	0.41-0.77
Monsoon	08	1.97-18.33	0.42-0.69

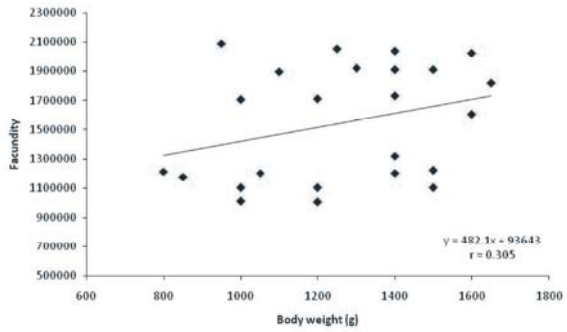

Fig. 1: Relationship between fecundity and body weight of *E. tetradactylum* from southeastern region of Bangladesh

The GSI of *E. tetradactylum* ranged from 1.04 to 18.33. The highest of GSI was recorded for mature stage in August and minimum GSI was found in April (1.04). The seasonal variation of GSI values was shown in Table 2. During the study period, relatively higher values of GSI were observed in the month of March (15.67), July (16.72) and August (18.33) which indicate the double peak once in March and other in July-August, which indicates that this fish breeds double annually. The findings of the present study concur with the findings of Kagawade [13]. However, some studies reported that *E. tetradactylum* has a very prolonged spawning season extending throughout the year, except winter. Studies by David [14] reported that the *E. tetradactylum* in the Hoogly River spawn during March to June.

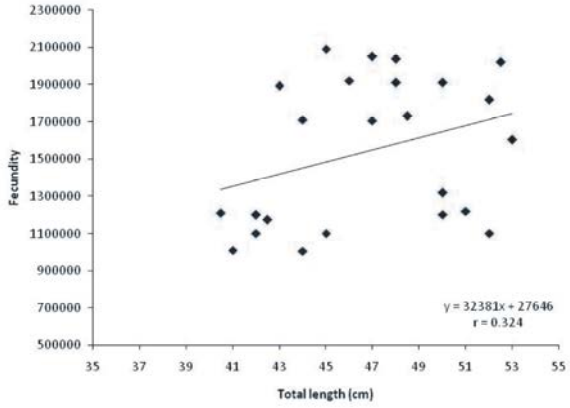

Fig. 2: Relationship between fecundity and total length of *E. tetradactylum* from southeastern region of Bangladesh

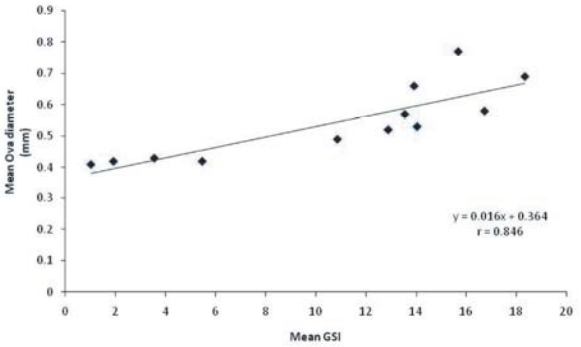

Fig. 3: Relationship between mean ova diameter and GSI of *E. tetradactylum* from southeastern region of Bangladesh

Ova diameter of *E. tetradactylum* ranged from 0.40 mm to 0.79 mm. The highest value of ova diameter was recorded for mature stage. The minimum and maximum ova diameter was found in pre-monsoon (Table 3). The ova diameter of *E. tetradactylum* was highly corrected with the GSI (Figure 1), probably due to the uptake of fluid by fully ripe oocytes [9]. Observation of fecundity revealed that berried females of *E. tetradactylum* carried about 1005219.00 to 2091927.00 eggs (Table 1). The fecundity was found minimum when the fish was having 44 mm of total length and body weight of 1200 g, while maximum fecundity was found in a fish having total length of 45 cm and body weight of 950 gm. The fecundity was not related to total body weight ($r = 0.305$, $p>0.05$) and total length ($r = 0.324$, $p>0.05$) of *E. tetradactylum* (Figures 2 and 3). This relationship revealed that body weight and body length could not influence the number of eggs of this fish. However, variation of fecundity is very common in fish and has been reported by many researchers like Kader [9], Doha and Hye [15], Shafi and Mustafa [16], Das [17], Mian and Dewan [18], Shafi *et al.* [19] and Aziz and Kader [20] and numerous factors including nutritional state [21] racial characteristics [22] and the time of sampling ad maturity stage [23] have been suggested to explain variation in fecundity both within and between fish populations. In general, fecundity may be defined as a season's crop or the number of eggs released by an individual fish during a spawning season and the study of fecundity is important to have a full understanding the periodicity of spawning [24].

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